DESIGN OF LOAD BEARING BRICKWORK SYSTEMS

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DESIGN OF LOAD BEARING BRICKWORK SYSTEMS

by

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28/5/2000

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(Supervisor)

Date

Special dedication to my beloved and understanding

Father and Mother

Thanks for everything & may Allah s.w.t bless you

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ABSTRACT

Many low-rise buildings have been constructed using structural steel or reinforced concrete frames combined with brick infill wall. Although this form of construction provides strong, durable walls with many desirable properties, such as excellent fire resistance and sound transmission characteristics, use of load-bearing brick has the potential to provide more cost-effective buildings. Besides that, use of load bearing wall also have more advantages such as faster construction, strength, durability and more fire resistance.

Purpose of this research to study the design of load bearing wall by using the common clay bricks. The design according to British Standard (BS) 5628, Part: 1, Unreinforced masonry.

ABSTRAK

Kebanyakkan rumah kos rendah setingkat banyak dibina menggunakkan kaedah struktur besi atau rangka stuktur konkrit bertetulang, "Reinforced concrete" yang digabungkan dengan dinding bata. Walaupun kaedah pembinaan ini adalah kukuh dan kuat serta dinding yang tahan dengan banyak ciri-ciri lain baik kepada rintangan haba dan pemindahan bunyi, tetapi kos pebinaannya adalah terlalu tinggi. Penggunaan kaedah " Load Bearing Wall " mempunyai potensi untuk megurangkan kos pembinaan sesuatu bangunan.

Selain itu pengunaan kaedah " Load Bearing Wall " mempunyai banyak kelebihan seperti tempoh pembinaan yang cepat, kukuh, tahan dan sangat tahan kepada rintangan haba berbanding kaedah " Reinforced Concrete ".

Tujuan kajian ini adalah untuk mempelajari kaedah rekaan " Load Bearing Wall " dengan menggunakan bata tanah liat biasa berpandukan " British Standard 5628 : Part: 1, Use of unreinforced masonry ".

TABLE OF CONTENTS

CHAPTER 2 : LITERATURE REVIEW

CHAPTER 3 : DESIGN PRINCIPLES

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

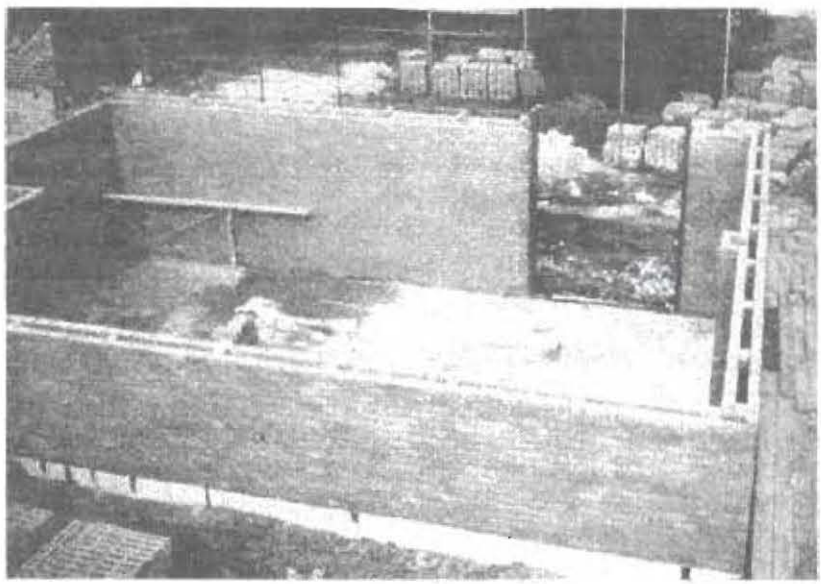


Figure 1.1 House constructed use load bearing system.

1.1 GENERAL

Load-bearing wall system is one of the types of construction of the structures. This method is the oldest form of construction. The old bridges, the pyramids are just same of the examples. Almost all the pre war building in Malaysia uses this method like the Sultan Ahmad Samad building. With the introduction of concrete and steel bars to Malaysia, the reinforced concrete frame system with brick infill walls become more

popular. As time goes by, many of the Engineers became very used to designing R.C frames and tend to either forget or feel less confident about load bearing wall construction. However, internationally, load bearing walls constructions are widely used in USA, Canada, France, Germany and New Zealand and durable until today.

In Malaysia, there has always been a need to construct houses cheaper and faster to meet the growing demand for them. In the instances, building materials especially steel and concrete are becoming ore expensive and quite often there is shortage of these materials. In the effort to overcome this national problem, Load Bearing Brickwork construction method are used to change the RC frames system, especially for single storey low-cost housing. Load bearing brickwork system, which has proven to be not only cost and time effective, but also easily implemented and well supported by our building industry's infrastructure. Figure 1.1 shown the example the house constructed use of load bearing wall system.

1.2 OBJECTIVES:

The aims of this thesis:

a) to reintroduce an old building construction method called "Load Bearing Brickwork" as a more suitable alternative to the conventional method.
b) to study how to design single storey load bearing building according to BS 5628: Codes of practice for use of masonry, Part: 1, Unreinforced masonry.

1.3 METHODOLOGY:

Case study

A case study was redesign a single storey terrace house for Rancangan Perumahan Rakyat (RPR) Batu Kawa Kiri, Jalan Batu Kawa, Kuching. Designs are use of load bearing brickwork method according to BS 5628, Part: 1. The architectural drawings get from Jabatan Suruhanjaya Perumahan dan Pembangunan Sarawak (SPPS). Besides that the study also involves a research about the single load bearing buildings.

Chapter 2

LITERACTURE REVIEW

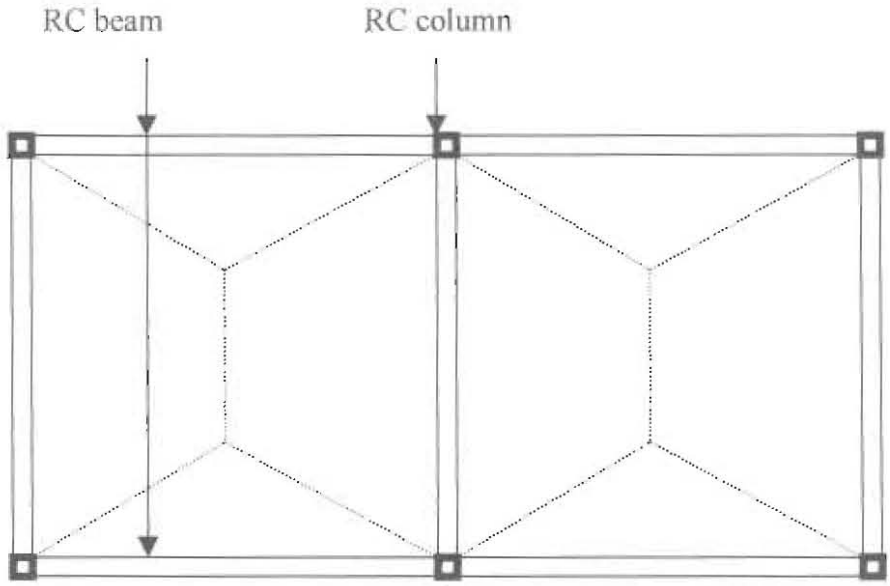
2.1 Difference between Reinforced Concrete Frame System and Load-bearing System.

Reinforced concrete frame system and load-bearing system is two-difference method of construction. The method of design for reinforced concrete structures are generally according to BS 8110 (*Structural use of concrete, Parts 1,2 and 3*). The method of construction where the load transfer from the roof to the beam. Then the load from the beam will support by the column to the foundation. The brickwork in R.C frame structures merely acts as nonstructural partitions.

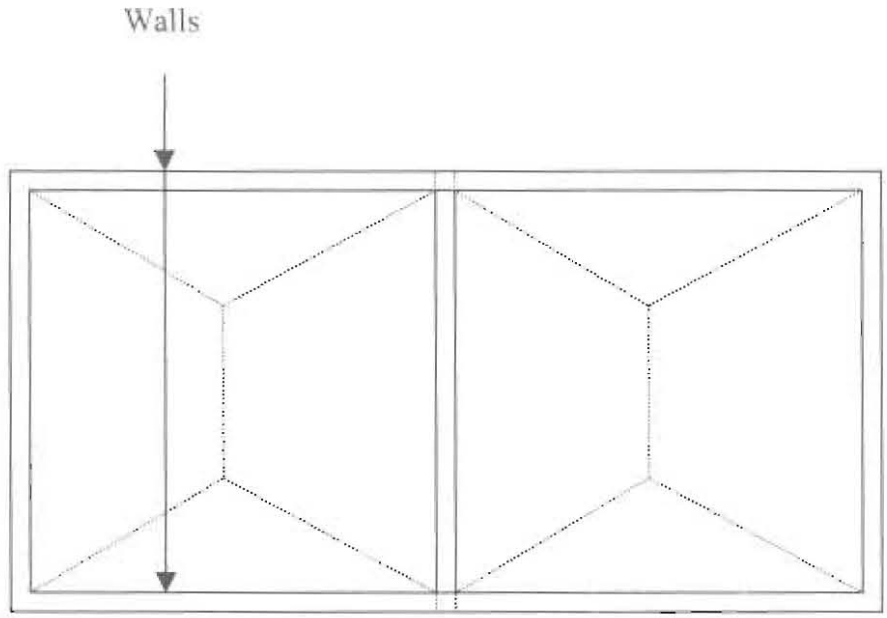
Meanwhile, the load-bearing system where the brick walls are used to support all structural loads imposed by the roof, upper wall and floor slaps and lateral load such as wind and soil pressure. The method of design for load-bearing system is generally according to BS 5628, Part 1 and 2.

In the Load Bearing system, the masonry-walls are designed taking into account the strength and type of masonry to be used which can be concrete block or clay brick. The factor safety adopted in the design has to exceed the minimum factor of safety stipulated in the British Standard 5628.

Raft foundation is usually used to support the loads from the walls and in some cases where the soils unfavorable, piles may still be required. That is differ to the R.C frames systems where the pad footing (squire *footing*) are usually used to support overall building (*including piling*). Figure 2.1 and 2.2 shows the differentiate between the R.C frame systems and load bearing systems.



(a) RC frame systems – load from slab / roof to beam to column to foundation



(b) Load bearing walls – load from slab / roof to wall to foundation

Figure 2.1 A comparison of load transfer between RC frame system and the load bearing wall by the top veiw.

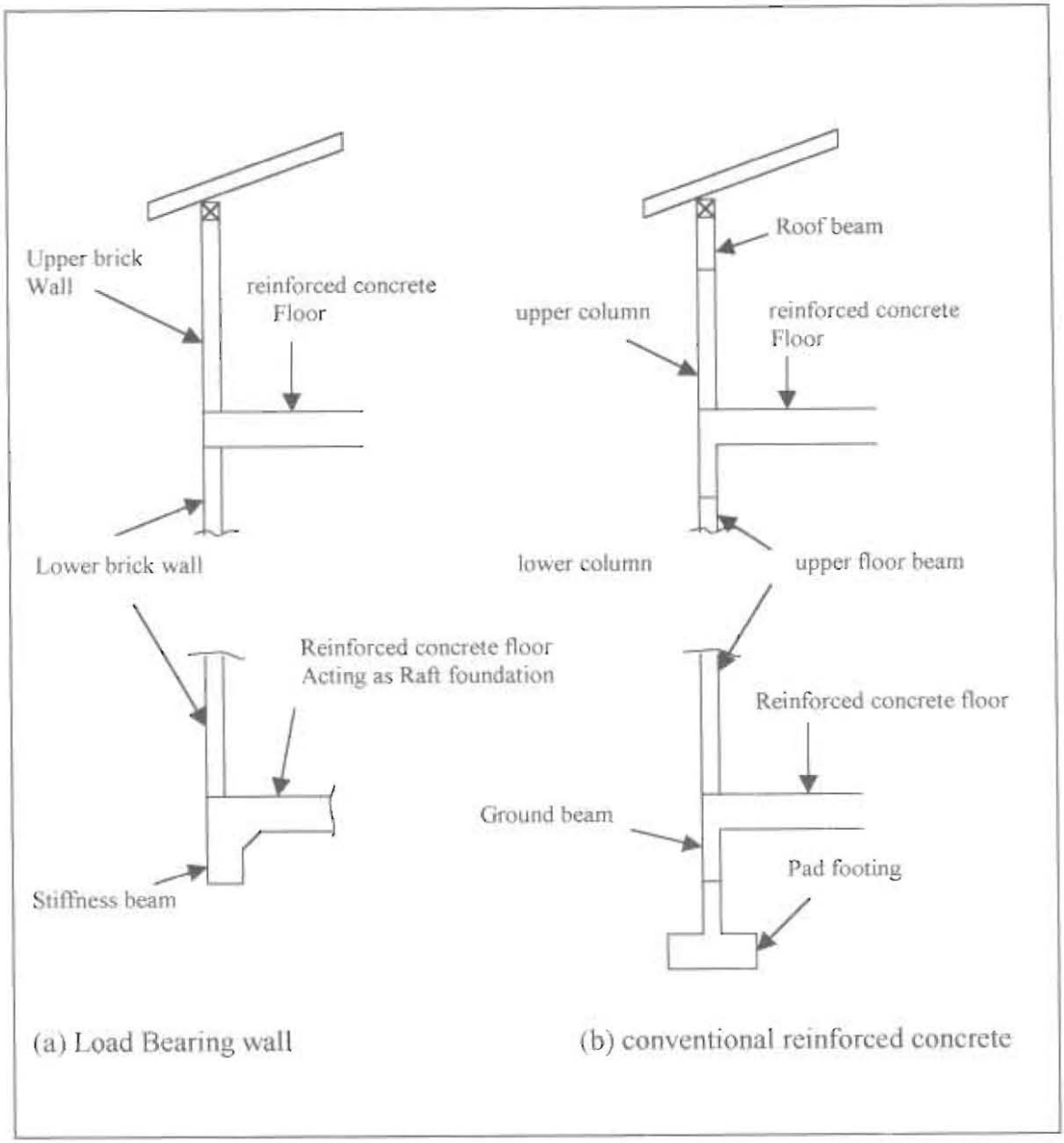


Figure 2.2 Typical load bearing wall and reinforced concrete building elements by side view.

2.2 Masonry Building Systems

2.2.1 Single-storey Load Bearing Building systems

Single-storey buildings make up the majority of load bearing masonry construction. Typical examples are warehouses, industrial buildings, bank and commercial stores. Singles family detached housing also employs single-storey load bearing walls. In these applications, load bearing masonry walls the exterior envelope walls. Figure 2.3 shows the main features of a one-story masonry building.

Thin walls are used for economic reasons and since unreinforced free-standing thin walls have negligible stability, they must be laterally support in some way. Stability is achieved by using end walls, intermediate cross walls, support along the top edge of the wall, or a combination of these. A lateral support along the top edge of the wall is usually provided by the roof or ceiling system.

Wind pressure acting on the exterior walls are transferred by them to support provided by the floor, roof, end walls, and cross walls. The portion load of load transferred to the roof level is in turn transferred by the roof or ceiling system. acting a stiff diaphragm in its own plane, to cross walls and end walls. The components of load distributed to the end walls and cross walls are then transmitted through these walls by shearing action to the foundation.

Wall A (Figure 2.3) is likely to be a critical element in resisting wind pressure because it is only supported along the top and bottom. With lightweight roof construction and reduced weight of thin walls, out-of-plane vertical bending in tall walls may produce tensile stresses that require the wall to be reinforced. Axial compressive loads and horizontal shear are usually small in single-story buildings and can easily be resisted even though thin walls are used.

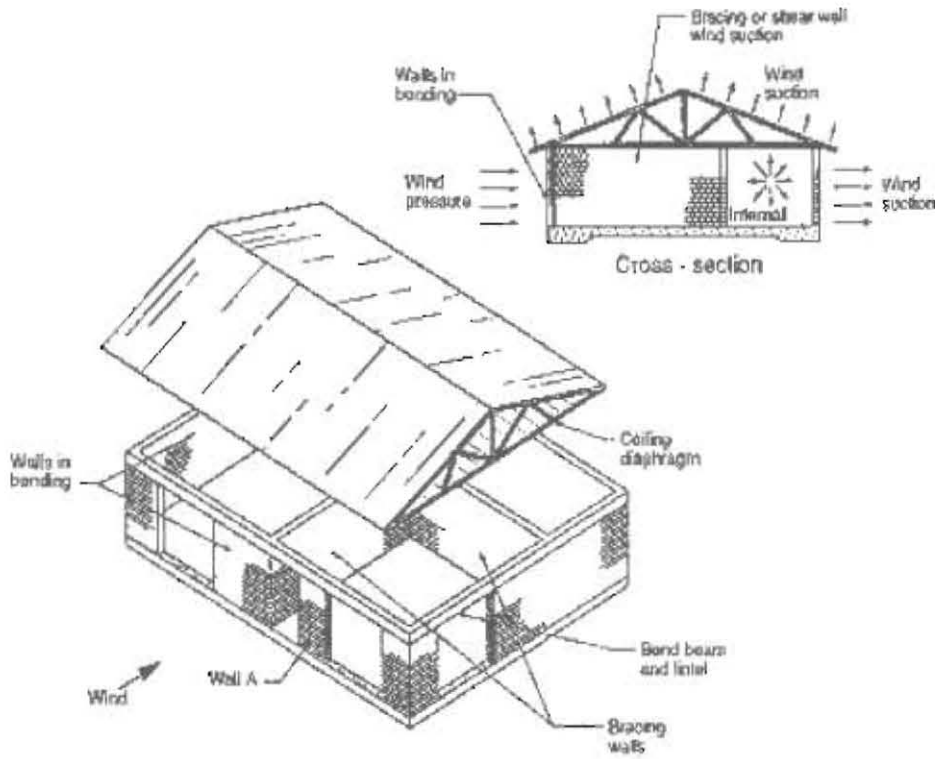


Figure 2.3 Structural action of a single storey structure

2.3 Types of masonry construction

Each of the masonry building systems described, until recent times, been constructed of unreinforced masonry. As wall thickness have been reduced and distances between support increased, reinforced and prestressed masonry have been introduced.

2.3.1 Unreinforced Masonry

Unreinforced masonry is the good method can be used in low and medium-rise buildings in areas of low seismic activity. Plain masonry elements (*concrete block or clay brick*) are the simplest to construct as they contain no reinforcement other than possible inclusion of light joint reinforcement to control shrinkage cracking. Therefore, they rely on the strength of the masonry alone to resist load. Because masonry is strong in compression but weak in tension, unreainforced masonry has great resistance to load cousing tensile stresses. Therefore, tensile stresses in unreinforced masonry must be designed to values below the tensile strength or the section is assumed to crack.

2.3.2 Reinforced Masonry

Reinforcement is mainly incorporated in masonry to resist tensile and shear stresses and to provide adequate ductility. Initially, bending stresses due to the lateral load are less than the stresses due to axial compression. Tensile stresses develop in the masonry with increased lateral load and as lateral load increases further, the